

WHAT IS CLAIMED IS:

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1. A method for reducing an electromagnetic disturbance wave generated at an electronic apparatus, by covering the electronic apparatus with a housing which is formed by a material having a shield effect  
10 against an electromagnetic wave; comprising:  
                  providing a space forming part for radiation of heat or wiring at the housing, so that a longitudinal direction of the space forming part is along a surface electric current distribution in a  
15 case where the space forming part is not provided at the housing.

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2. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein the housing is formed by a material including a conductor or a semiconductor which has a volume resistivity of less than or equal to  $10^4 \Omega \text{cm}$ .

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3. The method for reducing an electromagnetic disturbance wave generated as claimed  
10 in claim 1,

wherein the space forming part is formed so as to have a slit shape or a rectangular shape, and the space forming part in the longitudinal direction is formed radially from a gush part or a  
15 concentration part of the surface electric current of the housing.

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4. The method for reducing an electromagnetic disturbance wave generated as claimed  
in claim 3,

wherein the housing has a rectangular  
25 parallelepiped shape, and

the space forming part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

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5. The method for reducing an  
10 electromagnetic disturbance wave generated as claimed  
in claim 1,

wherein the space forming part is formed so  
as to have a slit shape or a rectangular shape, and

the space forming part in the longitudinal  
15 direction is formed radially from a center part of a  
magnetic field situated at an inside part of the  
housing, calculated by a designated numerical formula.

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6. The method for reducing an  
electromagnetic disturbance wave generated as claimed  
in claim 1,

wherein a measurement of the housing is set so that a resonance frequency of an electromagnetic wave in the housing is generated only by a frequency higher than an upper limit frequency of an EMI  
5 (ElectroMagnetic Interference) regulation.

10 7. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein a hole forming part other than the space forming part is provided, and

15 a size of the hole forming part is set so as to be less than or equal to one fourth, more preferably less than or equal to one tenth, of the length of an electromagnetic wave to be reduced.

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8. The method for reducing an electromagnetic disturbance wave generated as claimed  
25 in claim 1,

wherein the space forming part is provided at an upper or lower part, or the upper and lower parts of the housing.

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9. The method for reducing an electromagnetic disturbance wave generated as claimed 10 in claim 1,

wherein the housing has a connection part, and

the connection part in the longitudinal direction is provided so as to be along the 15 longitudinal direction of the space forming part.

20 10. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein the housing has a connection part, and

the longitudinal direction of the connection part is along a surface electric current distribution in a case where the connection part is not provided at the housing.

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11. The method for reducing an  
10 electromagnetic disturbance wave generated as claimed  
in claim 10,

wherein the connection part in the  
longitudinal direction is formed radially from a gush  
part or a concentration part of the surface electric  
15 current of the housing.

20 12. The method for reducing an  
electromagnetic disturbance wave generated as claimed  
in claim 10,

wherein the housing has a rectangular  
parallelepiped shape, and

the connection part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

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13. The method for reducing an  
10 electromagnetic disturbance wave generated as claimed  
in claim 1,

wherein the housing has a connection part having a good electrical resistance and a connection part having a bad electrical resistance, and

15 the connection part having the bad electrical resistance in a longitudinal direction is along a surface electric current distribution in a case where the connection part having the bad electrical resistance is not provided at the housing.

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14. The method for reducing an  
electromagnetic disturbance wave generated as claimed  
in claim 13,

5       wherein the connection part having the bad  
electrical resistance in a longitudinal direction is  
formed radially from a gush part or a concentration  
part of the surface electric current of the housing.

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15. The method for reducing an  
electromagnetic disturbance wave generated as claimed  
in claim 13,

15       wherein the housing has a rectangular  
parallelepiped shape, and

the connection part having the bad  
electrical resistance in the longitudinal direction  
is formed radially from a gush part or a  
20 concentration part of the surface electric current  
calculated by a designated numerical formula.

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16. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein the space forming part is arranged  
5 in a direction in which a flow of a cooling medium  
for elimination of heat or air change is not  
disturbed.

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17. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

15 wherein a pipe for communicating between an inside and an outside of the housing is provided at the housing, and

20 a width of an opening part of the pipe is set so as to be less than or equal to a half of a wavelength of a frequency to be reduced.

18. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein a harness or an electrical wire or  
5 cord for communicating information or electric power  
between the electric apparatus situated at the inside  
of the housing and an outside of the housing, is  
provided at the housing, so as to not disturb a  
surface electrical current distribution in a case  
10 where the harness or the electrical wire or cord is  
not provided at the housing.

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19. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

wherein an electric optical conversion  
20 element for converting an electric signal of the  
electric apparatus provided at an inside of the  
housing to an optical signal, an optical fiber for  
sending the optical signal converted by the electric  
optical conversion element from the space forming  
25 part to an outside of the housing, and an optical

electric conversion element for converting the optical signal which is sent to the outside of the housing by the optical fiber to an electric signal, are provided,

5                   so that the electric signal of the electric apparatus in the housing is converted to the optical signal by the electric optical conversion element, the converted optical signal is sent from the space forming part to the optical electrical conversion 10 element at the outside part of the housing and is converted to the electric signal, and therefore information is communicated between the electric apparatus situated at the inside of the housing and the outside of the housing.

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20. The method for reducing an 20 electromagnetic disturbance wave generated as claimed in claim 1, wherein an electric infrared conversion element for converting an electric signal of the electric apparatus provided at an inside of the 25 housing to an infrared signal, and an infrared

electric conversion element for converting the infrared signal which is converted by the electric infrared conversion element to an electric signal, are provided,

5 so that the electric signal of the electric apparatus in the housing is converted to the infrared signal by the electric infrared conversion element, the converted infrared signal is sent from the space forming part to the outside part of the housing, and  
10 10 the infrared signal sent to the outside part of the housing is converted to the electric signal by the infrared electric conversion element, and  
therefore information is communicated  
between the electric apparatus situated at the inside  
15 of the housing and the outside of the housing.

20 21. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,  
wherein a heat pipe for radiating heat generated at the electric apparatus provided at the  
25 inside of the housing to an outside part of the

housing, is provided along a wall surface of the housing.

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22. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

10 wherein the housing is formed by a metal material.

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23. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 1,

20 wherein the housing has an internal surface or external surface where a thin film formed by a conductor is applied.

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24. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 23,

wherein the housing is formed by a material 5 having a volume resistivity of greater than or equal to  $10^8 \Omega \text{cm}$ , and

the housing has an internal surface or external surface where a thin film formed by a material having a volume resistivity of less than or 10 equal to  $10^{-4} \Omega \text{cm}$  is applied.

15 25. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 24,

wherein the housing is formed by a plastic material, and

20 the housing has an internal surface or external surface where a metal thin film is applied.

26. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 23,

wherein a thickness of the thin film is  
5 greater than a skin depth of a skin effect at a lower limit frequency under an EMI (ElectroMagnetic interference) regulation.

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27. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 23,

15 wherein the thin film layer is glued to the housing via an adhesion layer, and  
a sticking part of the thin film, for gluing the thin film layer, is provided in a direction along a surface electric current distribution of the  
20 housing in a case where the sticking part is not provided.

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28. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 27,

wherein the sticking part of the thin film  
5 layer in the longitudinal direction is formed  
radially from a gush part or a concentration part of  
the surface electric current of the housing.

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29. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 28,

15 wherein the housing has a rectangular  
parallelepiped shape, and

the sticking part for the thin film layer in  
the longitudinal direction is formed radially from a  
gush part or a concentration part of the surface  
20 electric current calculated by a designated numerical  
formula.

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30. The method for reducing an electromagnetic disturbance wave generated as claimed in claim 23,

wherein a metal pipe for communicating  
5 between an inside and an outside of the housing is provided at the housing so as to come in contact with the thin film layer.

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31. A housing structure for reducing an electromagnetic disturbance wave generated at an electronic apparatus, by covering the electronic  
15 apparatus with a housing which is formed by a material having a shield effect against an electromagnetic wave; comprising:

a space forming part for radiation of heat or wiring at the housing,

20 wherein a longitudinal direction of the space forming part is along a surface electric current distribution in a case where the space forming part is not provided at the housing.

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32. The housing structure as claimed in  
claim 31,

wherein the housing is formed by a material  
including a conductor or a semiconductor which has a  
5 volume resistivity of less than or equal to  $10^4 \Omega \text{cm}$ .

10 33. The housing structure as claimed in  
claim 31,

wherein the space forming part is formed so  
as to have a slit shape or a rectangular shape, and  
the space forming part in the longitudinal  
15 direction is formed radially from a gush part or a  
concentration part of the surface electric current of  
the housing.

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34. The housing structure as claimed in  
claim 33,

wherein the housing has a rectangular  
25 parallelepiped shape, and

the space forming part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

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35. The housing structure as claimed in  
10 claim 31,

wherein the space forming part is formed so as to have a slit shape or a rectangular shape, and  
the space forming part in the longitudinal direction is formed radially from a center part of a  
15 magnetic field situated at an inside part of the housing, calculated by a designated numerical formula.

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36. The housing structure as claimed in  
claim 31,

wherein a measurement of the housing is set so that a resonance frequency of an electromagnetic  
25 wave in the housing is generated only by a frequency

higher than an upper limit frequency of an EMI  
(ElectroMagnetic Interference) regulation.

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37. The housing structure as claimed in  
claim 31,

wherein a hole forming part other than the  
10 space forming part is provided, and

a size of the hole forming part is set so as  
to be less than or equal to one fourth, more  
preferably less than or equal to one tenth, of the  
wavelength of an electromagnetic wave to be reduced.

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38. The housing structure as claimed in  
20 claim 31,

wherein the space forming part is provided  
at an upper or lower part, or the upper and lower  
parts of the housing.

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39. The housing structure as claimed in  
claim 31,

wherein the housing has a connection part,  
and

5           the connection part in the longitudinal  
direction is provided so as to be along the  
longitudinal direction of the space forming part.

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40. The housing structure as claimed in  
claim 31,

wherein the housing has a connection part,  
15    and

the longitudinal direction of the connection  
part is along a surface electric current distribution  
in a case where the connection part is not provided  
at the housing.

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41. The housing structure as claimed in  
25    claim 40,

wherein the connection part in the longitudinal direction is formed radially from a gush part or a concentration part of the surface electric current of the housing.

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42. The housing structure as claimed in  
10 claim 40,

wherein the housing has a rectangular parallelepiped shape, and

the connection part in the longitudinal direction is formed radially from a gush part or a  
15 concentration part of the surface electric current calculated by a designated numerical formula.

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43. The housing structure as claimed in  
claim 31,

wherein the housing has a connection part having a good electrical resistance and a connection  
25 part having a bad electrical resistance, and

the connection part having the bad  
electrical resistance in a longitudinal direction is  
along a surface electric current distribution in a  
case where the connection part having the bad  
5 electrical resistance is not provided at the housing.

10 44. The housing structure as claimed in  
claim 43,

wherein the connection part having the bad  
electrical resistance in a longitudinal direction is  
formed radially from a gush part or a concentration  
15 part of the surface electric current of the housing.

20 45. The housing structure as claimed in  
claim 43,

wherein the housing has a rectangular  
parallelepiped shape, and

the connection part having the bad  
25 electrical resistance in the longitudinal direction

is formed radially from a gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

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46. The housing structure as claimed in  
claim 31,

10           wherein the space forming part is arranged in a direction in which a flow of a cooling medium for elimination of heat or air change is not disturbed.

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47. The housing structure as claimed in  
claim 31,

20           wherein a pipe for communicating between an inside and an outside of the housing is provided at the housing, and

25           a width of an opening part of the pipe is set so as to be less than or equal to a half of a wavelength of a frequency to be reduced.

48. The housing structure as claimed in  
claim 31,

wherein a harness or an electrical wire or  
cord for communicating information or electric power  
5 between the electric apparatus situated at the inside  
of the housing and an outside of the housing, is  
provided at the housing, so as to not disturb a  
surface electrical current distribution in a case  
where the harness or the electrical wire or cord is  
10 not provided at the housing.

15 49. The housing structure as claimed in  
claim 31,

wherein an electric optical conversion  
element for converting an electric signal of the  
electric apparatus provided at an inside of the  
20 housing to an optical signal, an optical fiber for  
sending the optical signal converted by the electric  
optical conversion element from the space forming  
part to an outside of the housing, and an optical  
electric conversion element for converting the  
25 optical signal which is sent to the outside of the

housing by the optical fiber to an electric signal, are provided,

so that the electric signal of the electric apparatus in the housing is converted to the optical signal by the electric optical conversion element, the converted optical signal is sent from the space forming part to the optical electrical conversion element at the outside part of the housing and is converted to the electric signal, and

10 therefore information is communicated between the electric apparatus situated at the inside of the housing and the outside of the housing.

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50. The housing structure as claimed in claim 31,

wherein an electric infrared conversion 20 element for converting an electric signal of the electric apparatus provided at an inside of the housing to an infrared signal, and an infrared electric conversion element for converting the infrared signal which is converted by the electric

infrared conversion element to an electric signal,  
are provided,

so that the electric signal of the electric  
apparatus in the housing is converted to the infrared  
5 signal by the electric infrared conversion element,  
the converted infrared signal is sent from the space  
forming part to the outside part of the housing, and  
the infrared signal sent to the outside part of the  
housing is converted to the electric signal by the  
10 infrared electric conversion element, and

therefore information is communicated  
between the electric apparatus situated at the inside  
of the housing and the outside of the housing.

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51. The housing structure as claimed in  
claim 31,

20 wherein a heat pipe for radiating a heat  
generated at the electric apparatus provided at the  
inside of the housing to an outside part of the  
housing, is provided along a wall surface of the  
housing.

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52. The housing structure as claimed in  
claim 31,

wherein the housing is formed by a metal  
material.

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53. The housing structure as claimed in  
10 claim 31,

wherein the housing has an internal surface  
or external surface where a thin film formed by a  
conductor is applied.

54. The housing structure as claimed in  
15 claim 53,

wherein the housing is formed by a material  
having a volume resistivity of greater than or equal  
to  $10^8 \Omega \text{cm}$ , and

20 the housing has an internal surface or  
external surface where a thin film formed by a  
material having a volume resistivity of less than or  
equal to  $10^{-4} \Omega \text{cm}$  is applied.

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55. The housing structure as claimed in  
claim 54,

wherein the housing is formed by a plastic  
material, and

5 the housing has an internal surface or  
external surface where a metal thin film is applied.

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56. The housing structure as claimed in  
claim 53,

wherein a thickness of the thin film is  
greater than a skin depth of a skin effect at a lower  
15 limit frequency under an EMI (ElectroMagnetic  
Interference) regulation.

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57. The housing structure as claimed in  
claim 53,

wherein the thin film layer is glued to the  
housing via an adhesion layer, and

a sticking part of the thin film, for gluing the thin film layer, is provided in a direction along a surface electric current distribution of the housing in a case where the sticking part is not 5 provided.

10 58. The housing structure as claimed in claim 57,

wherein the sticking part of the thin film layer in the longitudinal direction is formed radially from a gush part or a concentration part of 15 the surface electric current of the housing.

20 59. The housing structure as claimed in claim 58,

wherein the housing has a rectangular parallelepiped shape, and the sticking part for the thin film layer in 25 the longitudinal direction is formed radially from a

gush part or a concentration part of the surface electric current calculated by a designated numerical formula.

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60. The housing structure as claimed in  
claim 53,

10                   wherein a metal pipe for communicating  
between an inside and an outside of the housing is  
provided at the housing so as to come in contact with  
the thin film layer.

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